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# INFLUENCE OF TEMPERATURE, RELATIVE HUMIDITY AND RAINFALL ON DEVELOPMENT OF SORGHUM DOWNY MILDEW DISEASE IN MAIZE (*ZEA MAYS* L.)

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***ABSTRACT***

***Sorghum downy mildew, considered as the top priority biotic constraint limiting maize productivity is caused by Peronosclerospora sorghi. UMI 79 (sorghum downy mildew susceptible) population was screened for sorghum downy mildew in sick plot condition and UMI 936(w) (sorghum downy mildew resistant) population was kept as control. Metrological observations viz., minimum- maximum temperature ($^0$C), relative humidity (%) and rainfall (mm) were recorded during each week. Plants were observed for the disease symptoms each week. Maximum disease buildup was observed in third and fourth week. In the third and fourth week average minimum and maximum temperature was recorded as 21.5$^0$C and 30.9$^0$C respectively, average relative humidity was 93.00% and average rainfall was recorded as 61.80 mm. Thus a temperature ranging from 20$^0$C to 30$^0$C, relative humidity above 90% and medium rainfall are found to be most conducive for development of sorghum downy mildew disease in maize.***

***KEYWORDS: Maize, Sorghum Downy Mildew, Climate***

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Original Article

## INTRODUCTION

Globally Maize (*Zea mays* L.) is known as queen of cereals because it has the highest genetic yield potential among the cereals. It is world's third most important crop after rice and wheat. Biotic stresses are one of the most limiting factors for stable crop production worldwide. Maize suffers from 130 pests and insects and about 110 diseases caused by fungi, bacteria and viruses on a global basis. Among the biotic constraint limiting maize productivity, downy mildew is considered the highest priority (Pingali, and Pandey, 2001). The major species causing downy mildew in maize in India are the sorghum downy mildew (SDM; *Peronosclerospora sorghi*), brown stripe downy mildew (BSDM; *Sclerophthora rayssiae* var. *zeae*) and Rajasthan downy mildew (RDM; *Peronosclerospora hetropogoni*).

Sorghum downy mildew (SDM) occurrence is more in peninsular India, Karnataka, Tamilnadu and Andhra Pradesh (Krishnappa *et al.*, 1995). The fungus spores are spread locally through the air. The disease can also be seed-borne and longer distance dispersal is facilitated by movement of infected seed or spore-contaminated soil. The pathogen infects maize roots first by oospores and the leaves by conidia and finally reaches the meristem causing systemic infection.

Production of conidia and sporangia in the field has a marked periodicity of release and has a close relationship with temperature, rainfall and relative humidity. All *Peronoporaceae* sp. Require surface wetness for

spore germination and infection and high relative humidity for spore production. Rainfall and high relative humidity are critical weather factors for epidemics to develop. Fungal infection of grain is very much dependent on the ambient humidity and is always higher after rain (Bandyopadhyay *et al.,* 2000).

Though pathogen primarily infects its host soon after seedling emergence, until one month after planting, disease can occur at any stage of maize development from seedling to harvest. This disease is recognized in two names, “downy mildew” and “crazy top” based on types of symptoms in maize that develop as a result of systemic infection. Infected seedlings are chlorotic (yellow) and stunted with symptoms most noticeable on the lower half of the first infected leaf and infected young plants may die. A white downy growth is produced on the lower leaf surface under cool, humid conditions. Chlorotic tissue stripes finally die and leaves become shredded. Heads produced are partially or fully sterile. Local infection symptoms are short necrotic streaks (stipples) produced on leaf blades. The most important symptom is the replacement of normal tassels by leaves. This is commonly referred to as crazy top symptom.

The following objective was designed for the present investigation

- To find out the conducive climate factors for sorghum downy mildew development.

## MATERIALS AND METHODS

The present study includes screening of UMI 79 (sorghum downy mildew susceptible) population in sick plot condition.

Sorghum downy mildew screening was carried out in kharif by taking advantage of monsoon season with low temperature which is conducive for pathogen development. 100 plants each of UMI 79 & UMI 936 were planted in rows in sick plot and disease pressure was created by spreader row technique.

Artificial disease epiphytotic conditions were created by planting spreader rows of CM 500, a susceptible maize genotype, 30 days prior to sowing of test entries. Spreader row technique used by Craig *et al*., (1976) was adapted for screening the maize genotypes against sorghum downy mildew in the field. Ridges were formed in 3m length with 60 cm between ridges after field preparation. The seeds of CM500 were sown in every $11^{th}$ row in sick plot leaving 10 rows in between to accommodate test entries 30 days later and also on all four sides of sick plot. The time gap (30 days) between spreader row sowing and test entries promotes disease development in spreader rows which forms the inoculums for infection in test entries.

Conidia of *P*. *sorghi* (obligate parasite), were harvested from fresh, infected plants for inoculations. The conidial inoculums preparation method used in this study was taken from Cardwell *et al*. (1994) and by utilizing the natural spore producing cycle of the fungus, which involved spray operation in the middle of the night (Siradhana *et al*., 1975; Renfro *et al*., 1979). Conidia were taken from three week old systematically infected maize plants. Maize leaves infected with *P. sorghi* showing visible symptoms were collected from the infected field previous day early evening. Infected leaves were wiped using wet absorbent cotton to remove old and matured downy mildew conidia produced and they were wiped again using tissue paper to remove moisture from the leaf surface. The sorghum downy mildew infected leaves were spread in a single layer over a tray lined with moist blotting paper with abaxial leaf surface faced upwards. The tray containing infected leaf materials was closed with another tray lined with moist blotting paper. The trays were incubated in the dark at $20^{o}$C for six to seven hours for sporulation, until 3.00 AM of next day morning. Then conidia were harvested by washing the sporulated leaves in chilled distilled water ($5^{o}$C) with a camel hairbrush. The conidial suspension was then filtered

through a double layered muslin cloth to remove conidiophores and other leaf particles. The resulting spore suspension was taken to the field in backpack sprayers. The spraying was done from 3.30 to 4.30 am on ten days old spreader row (CM 500) plants. After ensuring hundred per cent disease establishment in the spreader rows the test entries were planted so that test entries were exposed to infection by both oospores from the soil and conidia from spreader rows. Plants were observed for the disease symptoms each week. Number of plants infected in each week was noted down. Metrological observations *viz.*, minimum- maximum temperature ($^{0}$C), relative humidity (%) and rainfall (mm) were recorded during each week. Field views of the population have been given in Figure 1 and 2 and crazy top symptom developed has been presented in Figure 3.



**Figure 1: UMI 79 (Sorghum Downy Mildew Susceptible)** **Figure 2: UMI 936 (Sorghum Downy Mildew Resistant Check)**

**Figure 3: Crazy Top Symptom**

## EXPERIMENTAL RESULTS

UMI 79 (100 plants) and UMI 936(w) (100 plants) were phenotypically screened for sorghum downy mildew under sick plot condition by raising them in 3m rows with spacing of 60 x 25 cm. Artificial epiphytotic conditions were created by planting spreader rows of CM 500, a susceptible maize genotype, thirty days prior to sowing of test entries. UMI 79 and UMI 936 showed 94.60% and 90.62& germination respectively.

UMI 936(w) showed 100% resistance to sorghum downy mildew disease. Weekly temperature variation, relative humidity variation and rain fall variation are given in Figure 4, 5 & 6 respectively. Number of plants of UMI 79 population infected during each week is represented in Figure 7.

## CONCLUSIONS

Maximum number of plants showed the disease symptoms in third and fourth week. In the third and fourth week average minimum and maximum temperature was recorded as $21.5^0$C and $30.9^0$C respectively, average relative humidity was 93.00% and average rainfall was recorded as 61.80 mm. Thus a temperature ranging from $20^0$C to $30^0$C, relative humidity above 90% and medium rainfall are found to be most conducive for development of sorghum downy mildew disease in maize.

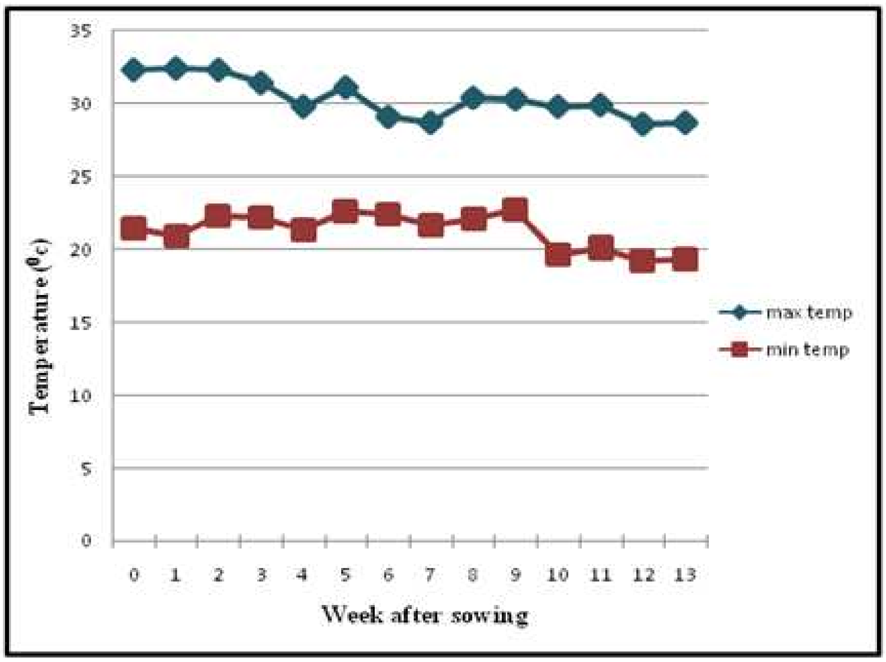


**Figure 4: Weekly Temperature Variation Recorded During Maize Growing Season**

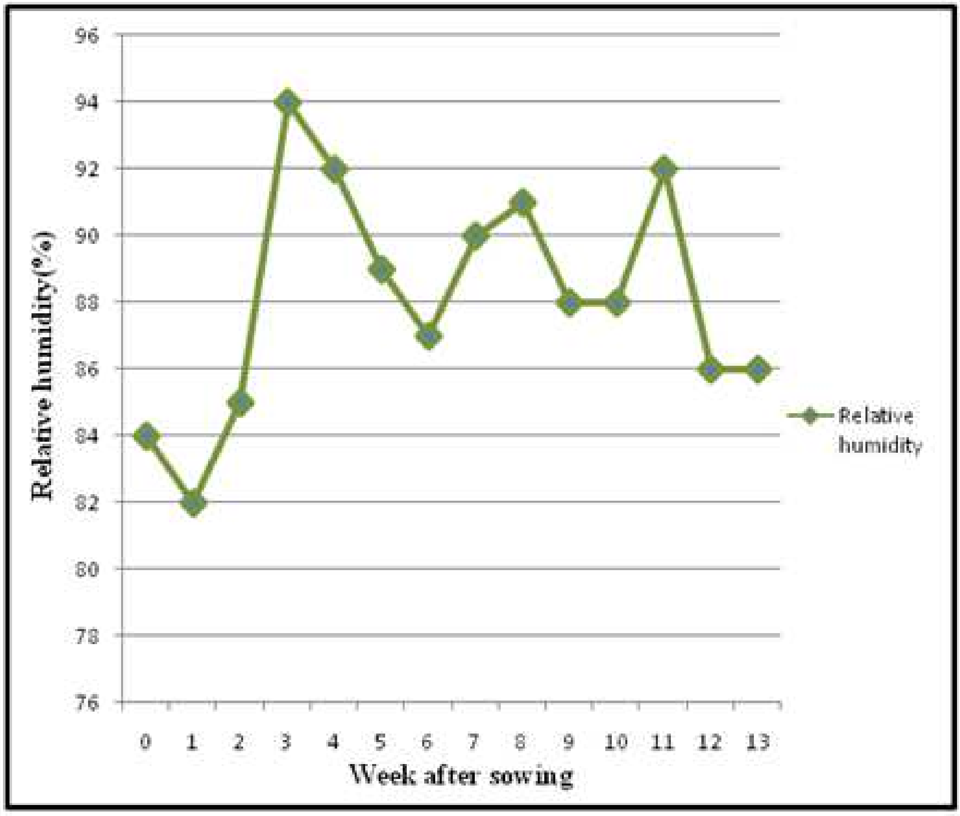


**Figure 5: Weekly Relative Humidity Variation Recorded During Maize Growing Season**

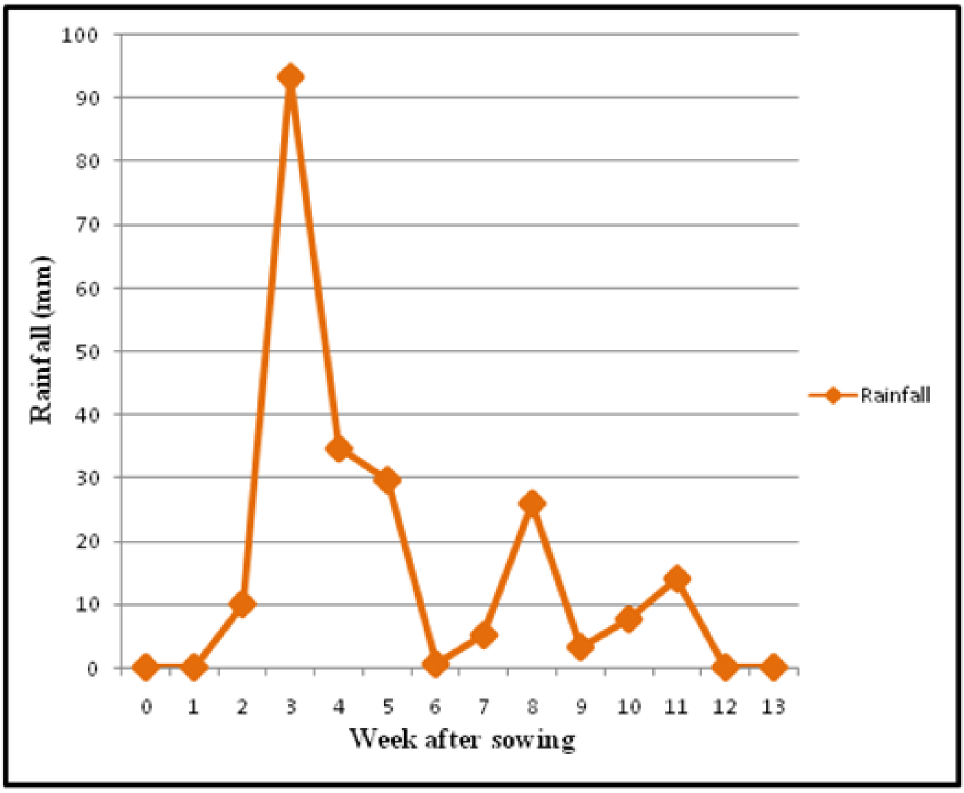


**Figure 6: Weekly Rainfall Variation Recorded During Maize Growing Season**

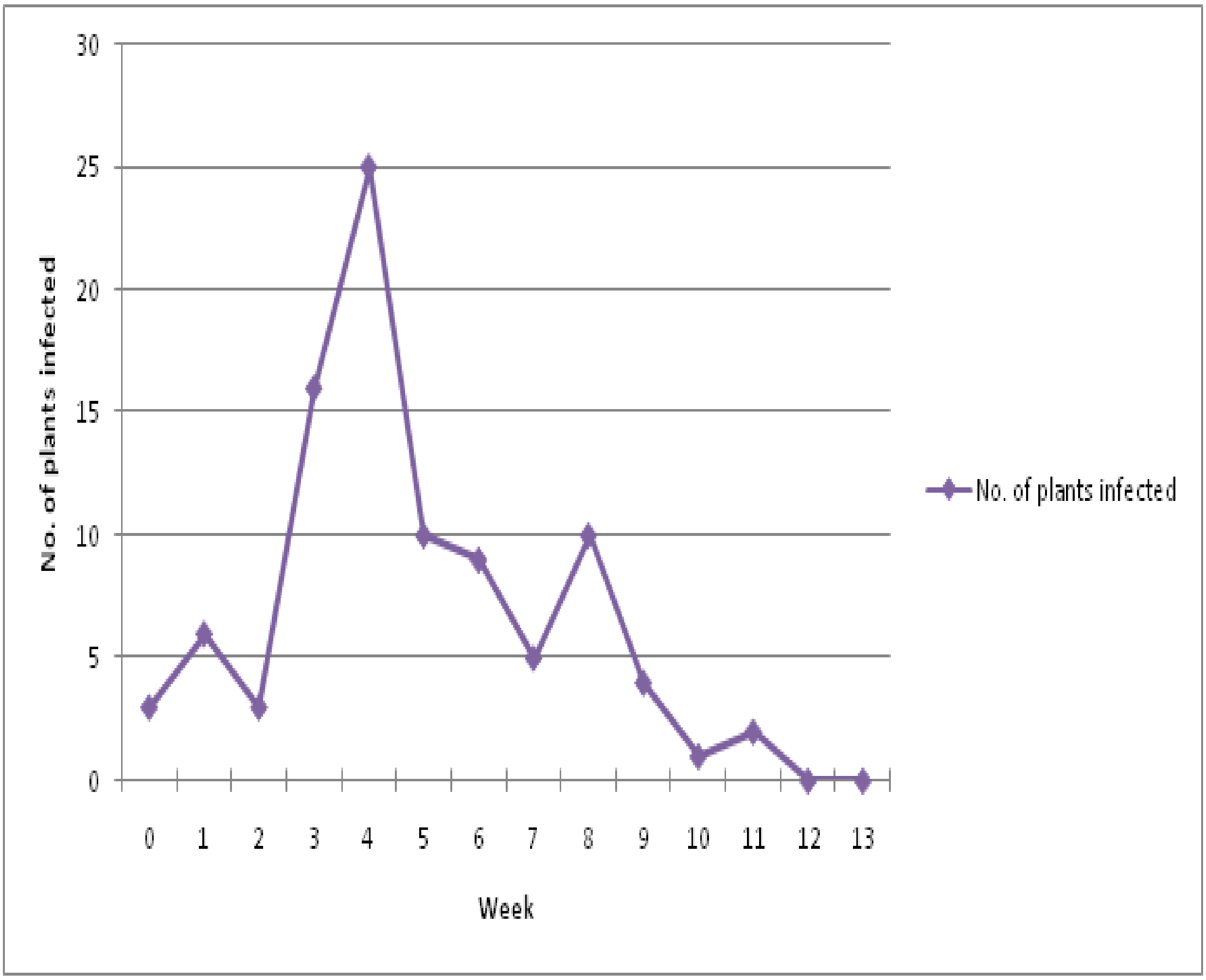


**Figure 7: No. of UMI 79 Plants Infected with Sorghum Downy Mildew during Each Week**

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